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Computational Thinking Analysis In Elementary School

Ainur Sakinah[1], Tatang Herman[2]

[1,2,3]Universitas Pendidikan Indonesia, Bandung, West Java, Indonesia

*ainursakinah21@upi.edu

Abstract. This study aims to determine how students apply computational thinking indicators in solving comparison problems. The method applied in this study is a descriptive qualitative approach involving four students as research subjects, where the four students were selected randomly. Each student is given one problem. This means that each student faces challenges in the form of different problems, but remains within the same context. This study was conducted on fifth grade students of SD Negeri 1 Panorama, Hegarmanah Village. The results of this test will be used to assess students' computational thinking skills in solving mathematical problems. In the decomposition indicator, students are generally able to break down problems into smaller parts, such as determining the elements that must be compared (the number of bottles of juice and mineral water). In the pattern recognition indicator, students are quite good at recognizing relationships or patterns between elements, such as ratios in comparisons, while the abstraction indicator is the biggest challenge for students, especially in filtering important information and ignoring irrelevant details. In addition, in the algorithm design indicator, some students still have difficulty designing systematic steps to simplify comparisons to their simplest form. Overall, students need a more structured learning approach that supports the development of CT skills, especially in abstraction and algorithm design, to improve their understanding of the comparison material. Therefore, it can be concluded that students have applied the four computational thinking indicators. Although there are still mistakes made by students in solving math problems, students have been able to apply the four foundations of computational thinking.

Keywords: Analysis, Computational Thinking , Elementary School.

INTRODUCTION

Education in the 21st century enables everyone to have critical thinking skills, knowledge and digital literacy skills, information literacy, media literacy and mastery of information and communication technology. (Syafitri et al., 2021) . Furthermore, according to the Ministry of Education and Culture's Research and Development (2013), the 21st century learning paradigm emphasizes students' ability to find out from various sources, formulate problems, think analytically and collaborate and collaborate in solving problems. This is part of *computational thinking skills* , which are important skills in the 21st century (Firdaus et al., 2022) . This skill is closely related to the use of technology. UNESCO proposes Computational Thinking as a thinking ability that complements the 4Cs (*Critical Thinking and Problem Solving*, *Creativity and Innovation*, *Communication*, *Collaboration*) as important skills in today's digital era. Computational Thinking (CT) is an important skill to have in this digital era. As an ability adapted from computer science, CT is a cognitive skill that is useful for training the brain to

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get used to thinking in a structured, critical, and logical manner. This ability is not only about designing or programming, but also compiling solutions to the design (Astuti et al., 2023)

Seymour Papert was the person who introduced the term "computational thinking" and then Jeanette Wing made the term popular. According to Wing, Computational Thinking is an approach to solving problems, organizing systems, and understanding one's attitude by explaining the basic theory of computation (Maharani et al., 2020) . This ability is seen as an individual's competence to analyze problems and express solutions to problems presented in algorithms processed by computers. This opinion is in line with Cahdriyana and Richardo (Zafrullah et al., 2024) , computational thinking is a way of finding solutions to problems by applying an algorithm such as applying techniques in programming. Meanwhile, according to Palts & Pedaste (2020) , computational thinking is the collection and analysis of data to understand problems in depth and then plan solutions with algorithmic thinking so that it focuses on the structure of the problem.

According to Alnashr & Nuraini (2022) Computational thinking is a way to understand and solve complicated or complex problems with computer science methods and theories such as abstraction, decomposition, algorithms, and pattern recognition that scholars see as skills that support many aspects of education in the 21st century. Through computational thinking skills, students are trained to formulate problems by breaking down or simplifying problems into small components so that they are easy to solve.

Computational thinking is a thinking process in formulating problems and strategizing in determining/choosing effective, efficient, optimal solutions to be carried out by information processing agents or solutions (Sitepu & Yahfizam, 2024).The characteristics of *computational thinking* are ideas, not artifacts. Computational thinking is not programming and not thinking like a computer, but rather finding solutions to problems using computers so that they help solve problems (Safitri et al., 2024) . In general, *computational thinking* is a cognitive activity that is associated with problem solving. In the implementation of *computational thinking,* affective elements are needed such as attitudes and beliefs about problems, and the individual's ability to solve problems. *Computational thinking* in the same way is not characterized by skills alone, but by attitudes (Nurhayati et al., 2017).

Computational thinking into mathematics learning aims to create mathematical activities that function as contexts that use *computational thinking strategies* to help deepen mathematical engagement (Zafrullah et al., 2024) . The integration of *computational thinking* into mathematics learning can be seen in problem-solving activities with decomposition stages that use pattern recognition, use algorithmic thinking and modeling, and abstraction of logical thinking in structured problem solving so as to be able to provide solutions to mathematical problems to other people and machines (Kallia et al., 2021) . This is evidenced by the results of the *Program for International Student Assessment* (PISA) 2022 recently announced on December 5, 2023, Indonesia is ranked 68th with a score; mathematics (379), science (398), and reading (371). Based on these data, it can be seen that the reading skills, mathematics skills, and science skills of Indonesian students are still far from the world average standard (Manullang & Simanjuntak, 2023) .

According to Dewi et al., (2024) computational thinking is important because in addition to the thinking process in developing computer applications, it also supports the thinking process with problem solving for other fields of science such as mathematics. The application of computational thinking in mathematics not only provides benefits in terms of mastering mathematical concepts, but also in developing more general thinking skills that can be applied to various other disciplines. Thus, the importance of computational thinking in mathematics cannot be underestimated, because the thinking skills developed through this approach will prepare students to face various more complex challenges, both in academic contexts and in their future professional lives.

Based on the results of observations and interviews with a number of fifth grade Mathematics teachers at SD Negeri 1 Panorama, Hegarmanah Village, it is known that many students still face difficulties in solving mathematical problems, especially in the comparison material. This difficulty is especially seen in the aspect of problem-solving abilities that require integration with the computational *thinking approach.* The obstacles experienced by students are related to the lack of basic understanding of the concept of comparison, the inability of students to analyze mathematical problems systematically, and the minimal use of logical or algorithmic thinking strategies in solving problems. (Akhmad et al., 2023) . According to the student, so far students have only focused on solving problems based on existing procedural examples. Furthermore, when they are given non-routine math problems, they have difficulty connecting calculations with theorems, and are unable to identify, recognize and develop patterns of relationships or equations to understand data or strategies used to strengthen their ideas (Nuraini et al., 2018).

So far, many students are only focused on solving problems based on existing procedural examples, so they have difficulty when given problems that are not routine or have a higher level of complexity (Sri & Sangila, 2018) . With a computational thinking approach, students

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can be trained to identify and understand problem structures, develop patterns of relationships between mathematical concepts, and apply more flexible strategies in solving problems (Murti et al., 2023) . In addition, this approach will help students connect calculations with underlying theorems, and provide them with the skills to develop their ideas more strongly using patterns of relationships or equations (Diantary & Akbar, 2022) . Thus, the integration of computational thinking in mathematics learning not only helps students overcome existing difficulties but also improves their critical and creative thinking skills in solving more complex and non-routine problems.

Research on Computational Thinking in Elementary Schools has also been studied by Rahayu et al., (2022) who said that Computational Thinking has become an important skill in the digital era of the 21st century, which involves the ability to solve problems, analyze data, and make decisions using computational principles. The results of the study showed that there was no significant difference between the computational thinking abilities of male and female students. While qualitatively, it shows that male and female students solve problems with different processes, especially in decomposition and abstraction skills, while no differences were found in pattern recognition and algorithmic thinking skills. Then the research conducted by Juldial & Haryadi (2024) examined the Analysis of Computational Thinking Skills in the Learning Process. The results of the study stated that student acceptance of computational thinking is also a challenge in education. This is because there are many aspects that need to be considered in computational thinking. Through the right approach, deep understanding, and application in real situations, students will be better prepared to face an increasingly digital world and increasingly advanced technology. Not only that, computational thinking has the potential to develop critical, imaginative, and rational thinking skills in dealing with complex problems, both in a computing environment and in everyday situations. This is in line with the research of Halimah et al., (2024) entitled Implementation of The Computational Thinking (CT) Approach to Improve Critical Thinking Skills in Class IV B Students at SD ICT Al-Abidin Surakarta . The results of his research stated that the critical thinking skills of students in class 4 of SDICT Al Abidin Surakarta can be improved through the application of the Computational Thinking approach.

Based on the description above, the researcher feels it is important to analyze the application of computational thinking skills by reasoning to solve problems through mathematics learning in Elementary School Grade V on comparative material . Therefore, the researcher chose the title "Analysis of *Computational Thinking in Elementary School* ".

METHODOLOGY

The method applied in this study is a descriptive qualitative approach involving four students as research subjects, where the four students were selected randomly. Each student is given one problem. This means that each student faces challenges in the form of different questions, but remains within the same context. This study uses a written test. The test is done individually by the four students. The results of this test will be used to assess students' computational thinking skills in solving mathematical problems. This test uses an instrument in the form of eight essay questions covering the material "comparison". This study was conducted on grade V students of SD Negeri 1 Panorama, Hegarmanah Village. The following is table I regarding computational thinking indicators.

CT Indicator	Description	Applications in Comparative Material
Decomposition	Students break down large problems into smaller, more solvable parts.	Students identify comparative elements, such as the number of bottles of juice and mineral water to be compared.
Abstraction	Students identify patterns or relationships that can facilitate problem solving.	Students select significant figures in comparative calculations and ignore additional irrelevant elements.
Pattern Recognition	Students ignore irrelevant details and focus on important aspects of problem solving.	Students recognize number patterns in comparisons, such as the greatest common factor (GCF) between 18 and 12.
Algorithm Design	Students develop structured steps or clear procedures to solve problems.	Students design steps to simplify comparisons to their simplest form, such as dividing a number by the GCF.

Tabel 1. *Students' Computational Thinking Process*

RESULTS AND DISCUSSION

This study aims to determine how students apply computational thinking indicators in solving comparison problems. The conditions of students in schools basically have their own uniqueness that we must facilitate according to the nature they have brought. Preparing a learning plan starting from an approach that facilitates learning styles, interests or attractions, and the readiness of students to follow learning needs to be considered, so that we prepare

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from the beginning what equipment we must prepare when we are going to face students. The following are the results of descriptive statistics on the value.

No	Statistics	Mark
1	N	4
2	Total Value	2150
3	Average	76.8
4	Standard Deviation	6.1
6	Max	83
7	Min	60

Tabel 2. *Computational thinking score results*

The results of the value show an average value of 50.8 from 4 students of SDN 1 Panorama Hegarmana on the comparison material of 8 questions. The reason for choosing 8 questions is because the *computational thinking* indicator consists of four important indicators so that each indicator has 2 questions each. Previous studies have analyzed how students' computational thinking abilities are. One of them is a study by (Safitri et al., 2024) on "Analysis of Students' Mathematical Computational Thinking Ability in Mathematics Learning" which obtained the results that the average value of 25 students was 33.25 with a maximum value of 68.75 and a minimum value of 0. The study concluded that students were good at applying *computational thinking* in mathematics learning.

To see the percentage of the comparative material *computational thinking indicator* which can be seen in the table below.

CT Indicator	%
Decomposition	83.33
Abstraction	70.78
Pattern Recognition	80.55
Algorithm Design	75.85

Table 3. *Percentage Results of Each Computational Thinking Indicator of Comparative Material*

The table above shows that the average results on the decomposition indicator (83.33%), abstraction (70.78%); pattern recognition (80.55%) and *algorithm design* (75.85%). Based on the table above, it can be seen that the average results on each indicator show the level of student achievement in computational thinking (CT) skills in elementary school. The following is an analysis of each indicator.

1. Decomposition (83.33%)

These results indicate that students have excellent ability in breaking down problems into smaller parts. This ability is important to understand the components of the problem separately so that it is easier to solve complex problems.

2. Abstraction (70.78%)

This indicator has the lowest average, indicating that students have difficulty filtering out important information and ignoring less relevant details. To overcome students' difficulties in filtering out important information in comparative materials, teachers can use visual and concrete strategies. For example, presenting comparisons in the form of tables or diagrams to separate important elements from additional information. In addition, teachers can provide practical examples that are relevant to students' daily lives, such as comparing prices of goods in the market to help students focus on the main elements of comparison, such as ratios or proportions. Gradual practice can also be applied, starting with simple problems involving only two elements of comparison, then slowly increasing to more complex problems. Collaborative learning, where students discuss in groups to determine important elements in comparative problems, can also help. Direct feedback from the teacher after the exercise will ensure that students understand how to ignore irrelevant details and improve their thinking skills.

3. Pattern Recognition (80.55)

The score on this indicator shows that students are quite capable of identifying patterns or similarities in data or problems. This ability helps students find solutions that can be applied to similar situations in the future.

4. Algorithm Design

These results indicate that students have quite good abilities in designing logical steps to solve problems. However, there is still room for improvement, especially in creating more effective and efficient algorithms.

Based on the results of interviews with high-ability students who worked on question number 1, students explained that they understood the steps to simplify the comparison between juice bottles and mineral water bottles. Students stated that the first step they took was to determine the number of each type of bottle, which was 18 bottles of juice and 12 bottles of mineral water. Next, students used the concept of the greatest common factor (GCF) to simplify the comparison. They identified the GCF of 18 and 12, which was 6, and then divided both numbers by 6. As a result, the simplified comparison was 3:2. Students also stated that they found these steps easy to understand because they had often practiced similar questions before.

Meanwhile, students with moderate abilities understand the basic concept of comparison but show difficulty in simplifying numbers. They can determine the number of bottles of juice (18) and bottles of mineral water (12) correctly, but are confused in finding the greatest common factor (GCF). In interviews, these students tend to try to divide both numbers by numbers they consider appropriate, such as 2 or 3, but do not get to the simplest form (3:2). They stated that the steps were confusing because they were not sure how to determine the GCF.

Low-ability students have difficulty even in understanding the problem. They can read the number of bottles of juice and mineral water, but do not know how to start solving the comparison. Some students try to divide numbers randomly, such as dividing 18 and 12 by the same number without a clear concept. When asked, they said that comparison is difficult material and they need more examples and explanations from the teacher. The results of the study on the analysis of computational thinking (CT) in fifth grade elementary school students in the comparison material show that students have varying abilities in each CT indicator. In the decomposition indicator, students are generally able to break down problems into smaller parts, such as determining the elements that must be compared (the number of bottles of juice and mineral water). In the pattern recognition indicator, students are quite good at recognizing relationships or patterns between elements, such as ratios in comparisons. This shows their potential to identify patterns that can be applied to similar problems.

However, the abstraction indicator is the biggest challenge for students, especially in filtering important information and ignoring irrelevant details. In addition, in the algorithm design indicator, some students still have difficulty designing systematic steps to simplify comparisons to their simplest form. Overall, students need a more structured learning approach and support the development of CT abilities, especially in abstraction and algorithm design, to improve their understanding of comparison materials. Therefore, it can be concluded that students have applied the four *computational thinking indicators* . Although there are still mistakes made by students in solving math problems, students have been able to apply the four foundations of computational thinking.

CONCLUSION

Based on the results of interviews and analysis of fifth-grade students' computational thinking (CT) abilities in comparison material, it can be concluded that students have been able to apply the four CT indicators decomposition, pattern recognition, abstraction, and algorithm design although with varying levels of mastery.

REFERENCES

Alnashr, MS, & Nuraini, L. (2022). Strengthening Computational Thinking Skills of Elementary Madrasah Teachers in Local Wisdom-Based Thematic Learning. *Kifah: Journal of Community Service* , *1* (1), 1–18. https://doi.org/10.35878/kifah.v1i1.392

Astuti, A., Lieung, KW, Mahuze, PN, Waluya, SB, Wardani, S., & Kudiai, D. (2023). Creative Thinking Ability of Pgsd Students in Elementary School Basic Mathematics Concepts Course. *Prima Magistra: Scientific Journal of Education* , *4* (2), 139–145. https://doi.org/10.37478/jpm.v4i2.2559

Dewi, JP, Lyesmaya, D., & Maula, LH (2024). The Effect of Problem Based Learning (PBL) Learning Model on Computational Thinking Skills in Grade IV Measurement Material . *Pendas: Scientific Journal of Elementary Education* , *09* (01), 3275–3285.

Diantary, VA, & Akbar, B. (2022). Comparison of Computational Thinking Skills Between Elementary Schools Accredited A and Elementary Schools Accredited B in Mathematics Subjects. *Jurnal Cendekia: Jurnal Pendidikan Matematika* , *6* (3), 2749–2756. https://doi.org/10.31004/cendekia.v6i3.1576

Firdaus, H., Laensadi, AM, Matvayodha, G., Siagian, FN, & Hasanah, IA (2022). Evaluation Analysis of the 2013 Curriculum Program and the Independent Curriculum. *Journal of Education and Counseling* , *4* (4), 686–692. https://core.ac.uk/download/pdf/322599509.pdf

Halimah, H., Khusnawan, ML, Subekti, RD, Atmojo, IRW, & Chasanah, AN (2024). Implementation of The Computational Thinking (CT) Approach to Improve Critical Thinking Skills in Class IV B Students at SD ICT Al-Abidin Surakarta. *Social, Humanities, and Educational Studies (SHES): Conference Series* , *7* (3), 755–761. https://doi.org/10.20961/shes.v7i3.91655

Juldial, TUH, & Haryadi, R. (2024). Analysis of Computational Thinking Skills in the Learning Process. *Basicedu Journal* , *8* (1), 136–144. https://doi.org/10.31004/basicedu.v8i1.6992

e-ISSN: 2808-8263
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Kallia, M., van Borkulo, S.P., Drijvers, P., Barendsen, E., & Tolboom, J. (2021). Characterizing computational thinking in mathematics education: a literature-informed Delphi study. *Research in Mathematics Education* , *23* (2), 159–187. https://doi.org/10.1080/14794802.2020.1852104

Maharani, S., Nusantara, T., Asari, AR, & Qohar, A. (2020). Computational thinking problem solving in the 21st century. In *Catalog In Publication …* (Issue January). https://www.researchgate .net/publication/347646698

Manullang, SB, & Simanjuntak, E. (2023). The Influence of Problem Based Learning Model on Computational Thinking Ability Assisted by Geogebra Media. *Journal on Education* , *06* (01), 7786–7796.

Murti, RDK, Adina, M., & Aprinastuti, C. (2023). Application of Computational Thinking in Mathematics Learning for Grade 1 at Kentungan State Elementary School. *PEDADIDAKTIKA: Scientific Journal of Elementary School Teacher Education* , *10* (2), 290–297. http://ejournal.upi.edu/index.php/pedadidaktika/index

Nuraini, Nursangaji, A., & Hamdani. (2018). Students' Thinking Process in Solving Mathematical Problems on Comparative Material Reviewed from Adversity Quotient. *Khatulistiwa Journal of Education and Learning* , *7* (3), 57–59.

Nurhayati, DM, Herman, T., & Suhendra, S. (2017). Analysis of Secondary School Students' Algebraic Thinking and Math-Talk Learning Community to Help Students Learn. *Journal of Physics: Conference Series* , *895* (1). https://doi.org/10.1088/1742-6596/895/1/012054

Palts, T., & Pedaste, M. (2020). A model for developing computational thinking skills. *Informatics in Education* , *19* (1), 113–128. https://doi.org/10.15388/INFEDU.2020.06

Rahayu, YD, Dewi, IC, Bahariawan, RA, Gumilang, AS, Aini, SN, & Dinata, NAS (2022). Introduction to Computational Thinking at SD Muhammadiyah 1 Jember Through Game Making Training Among Us. *Mattawang: Journal of Community Service* , *3* (4), 485–488. https://doi.org/10.35877/454ri.mattawang1275

Safitri, T., Ginting, TLB, Indriani, W., & Siregar, R. (2024). Analysis of Students' Mathematical Computational Thinking Ability in Mathematics Learning. *Numbers: Scientific Journal of Mathematics, Earth, and Space* , *2* (2), 10–16.

Sitepu, DFSB, & Yahfizam. (2024). Analysis of Literature Studies Improving Computational

Thinking Problem Solving Skills in Elementary Madrasah Students. *Numbers: Scientific Journal of Mathematics, Earth and Space* , *2* (3), 100–111.

Sri, SA, & Sangila, MS (2018). Mathematical Creative Thinking Ability of Students of SMP Negeri 9 Kendari on Flat Building Material. *Al-Ta'dib Journal* , *11* (2), 73–90.

Syafitri, E., Armanto, D., & Rahmadani, E. (2021). AXIOLOGY OF CRITICAL THINKING ABILITY. *Journal of Science and Social Research* , *4* (3), 320–325. https://doi.org/10.54314/jssr.v4i3.682

Zafrullah, Z., Gunawan, RN, Haidir, H., & Ramadhani, AM (2024). Implementation of the Use of Computational Thinking Skills in Children's Schools: Bibliometric Analysis (2014-2024). *Journal Binagogik* , *11* (2), 201–224.